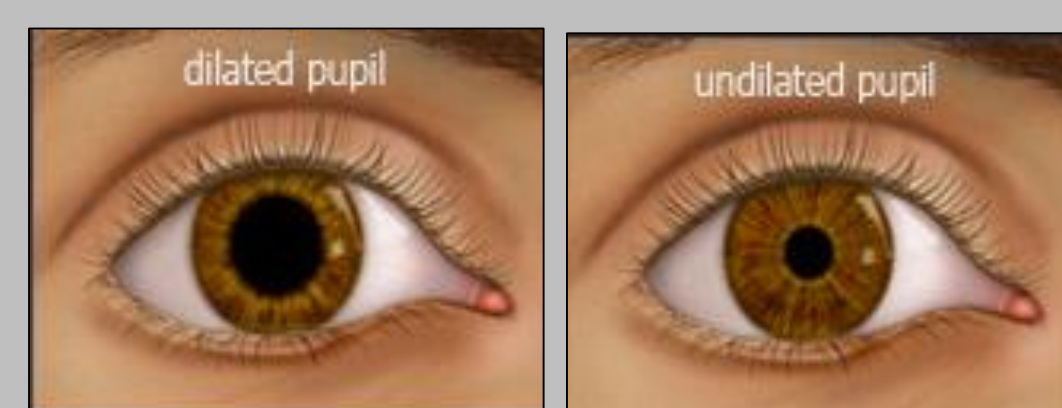


# Pupillary Responses to Manipulations of Stimuli Type and Synchrony in Children with Autism Spectrum Disorder

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## INTRODUCTION

- Pupil dilation is a physiological response that refers to the automatic expansion of the pupil (i.e., dilation).
- Pupillary response to visual and auditory stimuli is a reliable indicator of cognitive operations including preference<sup>1</sup>, mental load<sup>2</sup>, and emotional arousal<sup>3</sup>.



- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social communication and peer interactions<sup>4</sup>.
- The current study measured pupillary responses to social and non-social information to understand the underlying cognitive processes involved in social information processing in ASD and how these differ from typical development (TD).
- It has been hypothesized that individuals with ASD show cognitive differences that are specific to social communication.

### RESEARCH OBJECTIVES

- Determine if processing of asynchronous stimuli can be indexed through pupillary change, and if responses differ between TD and ASD.
- Determine if differences between pupillary responses to non-social and social information are driven by the processing of *social* or *linguistic* information.
- Determine if pupillary responses to stimuli relate to ASD symptomatology.

## REFERENCES

- Fitzgerald, 1968
- Granholm, Asarnow, 2006
- Bradley, Miccoli, 2011
- APA, 2013
- Anderson et al., 2006
- Klin et al., 2011
- Pierce, et al., 2011
- Chevallier et al., 2012
- Lahmir et al., 2015
- Ehlers et al., 2016

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## METHOD

### ANALYSIS

- Pupillary responses were recorded at a rate of 60 Hz, using a Tobii X60 eye-tracker.
- All trials were standardized for peak and average auditory volume, and visual luminance.
- Pupillary data were inspected for artifacts (i.e., blinks, loss of tracking, head movements) and corrected using linear interpolation. Useable data consisted of pupil traces at least 500ms in length in which artifacts did not make-up more than 20% of the pupil trace<sup>5</sup>.
- Average pupil diameter (across left and right pupil) was calculated for instances in which pupil data was captured in the area of interest.
- Mean pupil size was calculated for each stimulus condition and subtracted from mean pupil size of the preceding 1s of the inter-stimulus interval, which served as a baseline for each trial.

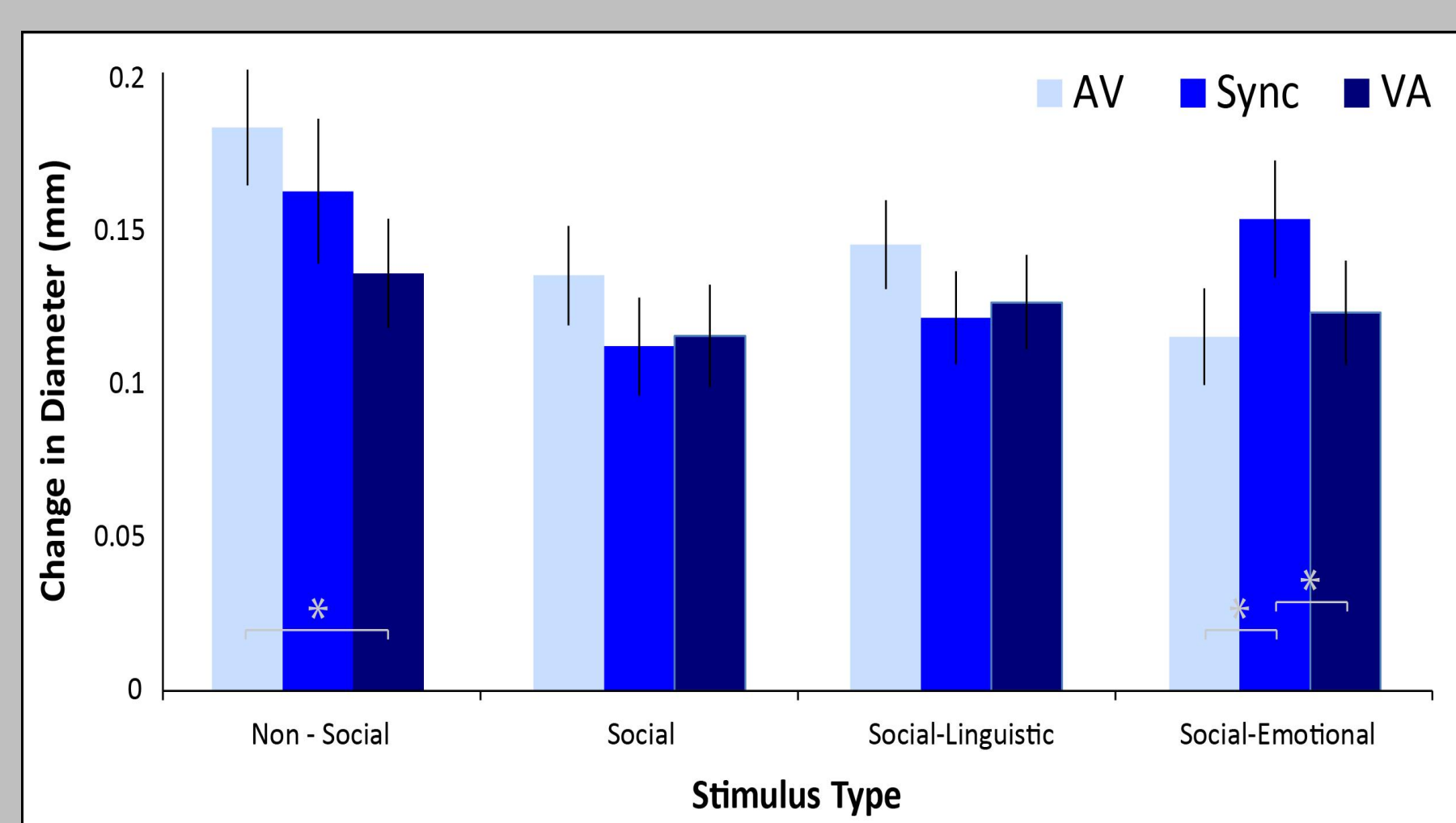
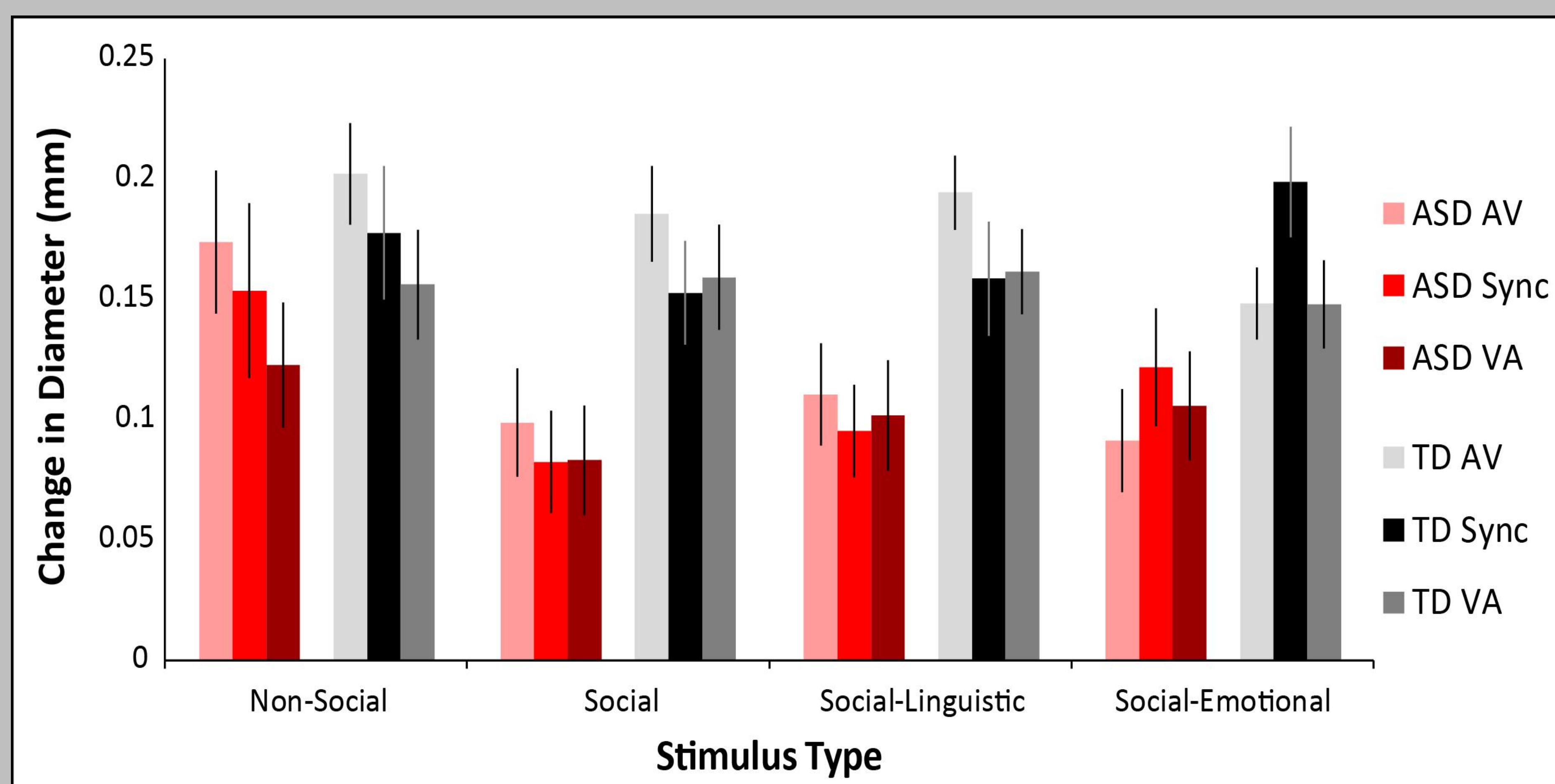
### PARTICIPANTS

Total N = 71	ASD (N = 39)	TD (N = 32)
Sex	M = 30 (76.9%)	M = 9 (28.1%)
Chronological Age	12.3 (3.2) yrs range = 6.8 – 20.0 yrs	12.4 (3.0) yrs range = 6.4 – 18.7 yrs
IQ	94.0 (22.2) range = 45 – 145	102.8 (10.6) range = 86 – 121
Mental Age	11.5 (4.2) yrs range = 4.9 – 20.3	12.7 (3.2) yrs range = 5.5 – 19.6

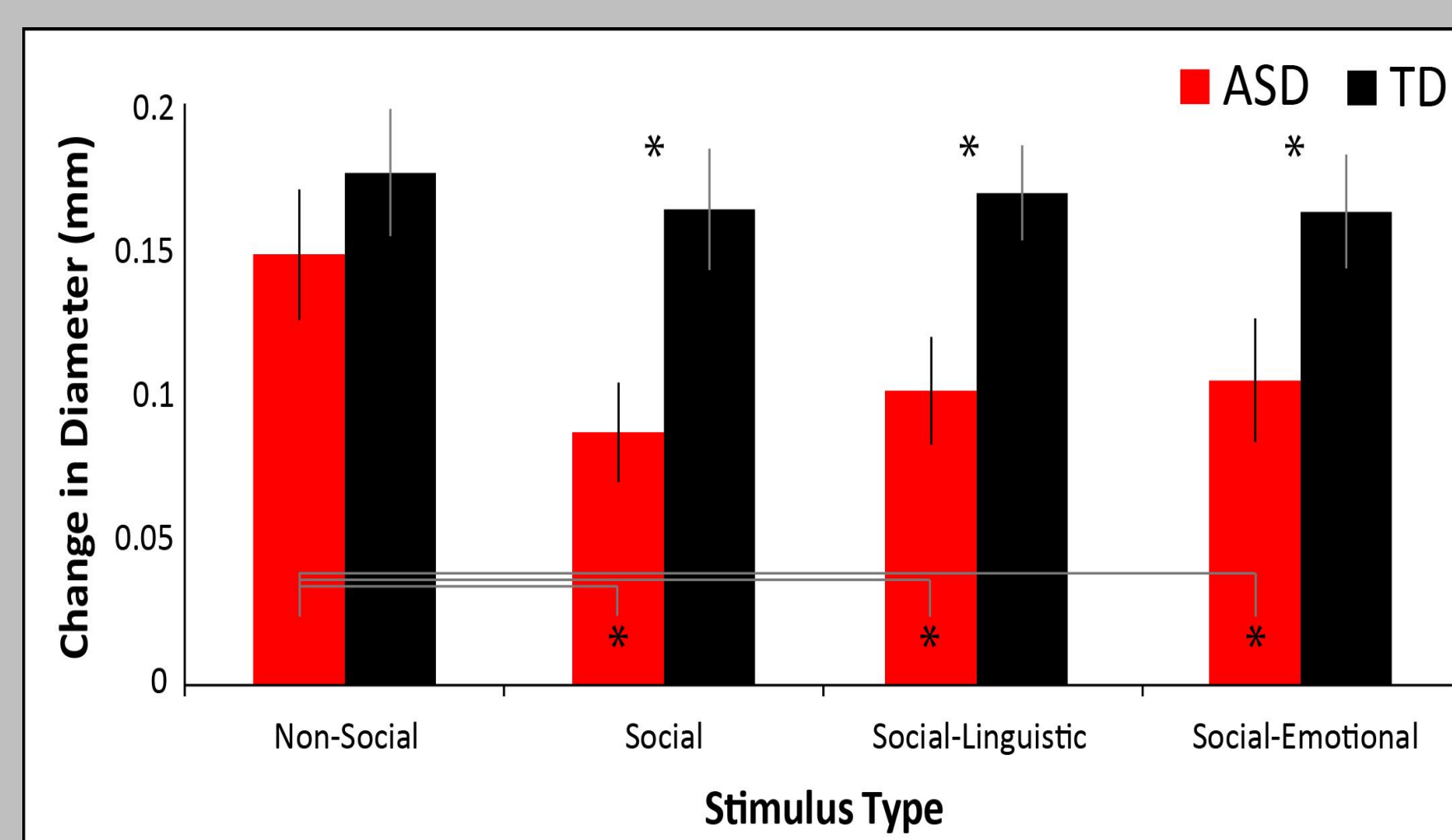
\* Diagnostic Measure: Autism Diagnostic Observation Schedule 2<sup>nd</sup> Edition (ADOS-2)

\* Intelligence Measure: Wechsler Abbreviated Scale of Intelligence – 2<sup>nd</sup> Edition (WASI-2)

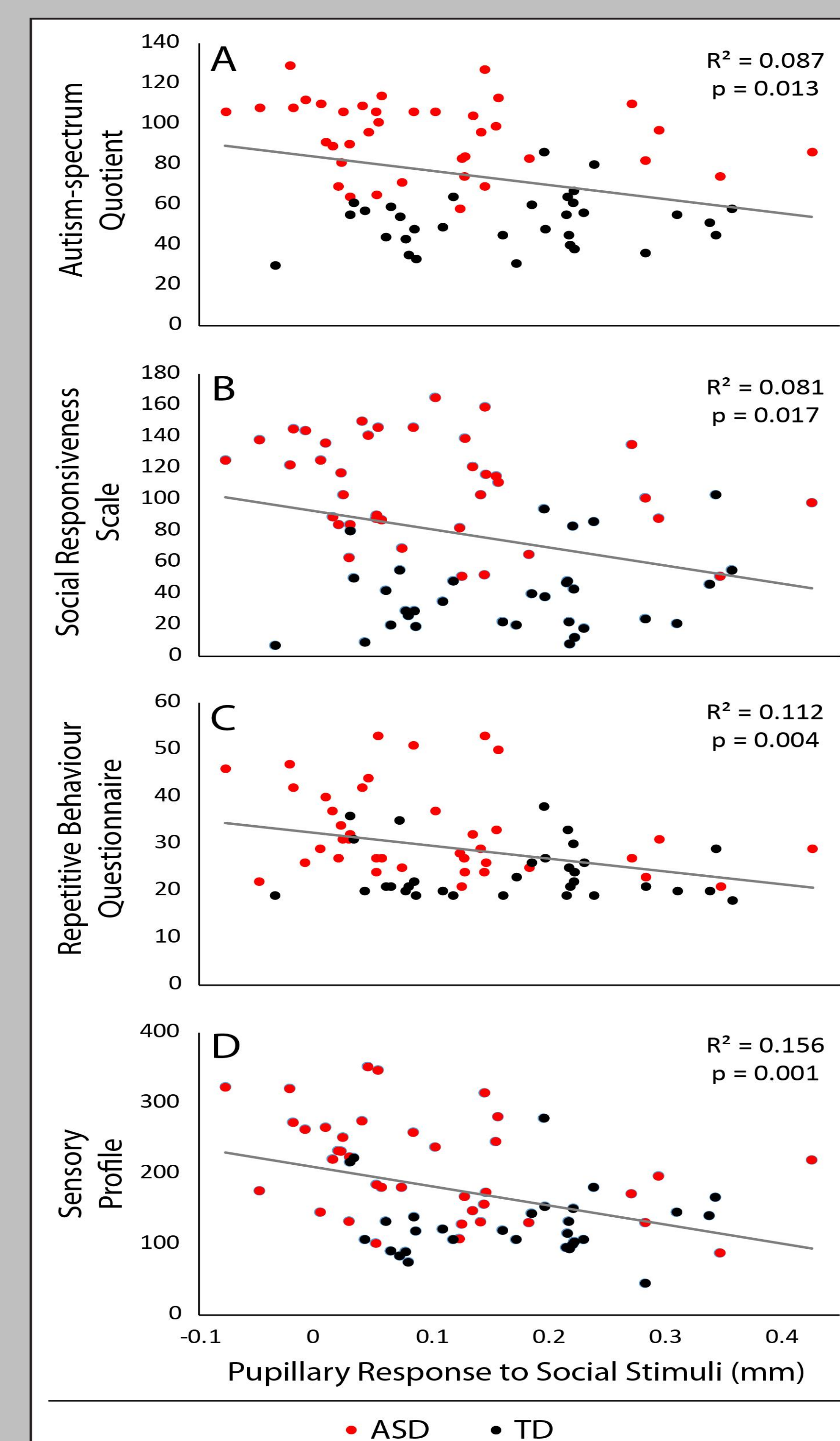
## RESULTS



**RESEARCH OBJECTIVE #1: Effect of Asynchrony on Pupil Size.** Both groups had similar patterns of response to asynchrony and exhibited a larger responses to audio-leading conditions, except for in the social-emotional condition.



**RESEARCH OBJECTIVE #2: Social versus. Non-Social.** Individuals with ASD had significantly smaller pupillary responses to all three social conditions, but were comparable to TD individuals in the non-social condition.



**RESEARCH OBJECTIVE #3: Relationship with Clinical Symptomatology.** Smaller pupillary responses were associated with an increase in ASD symptoms across multiple measures of ASD symptom severity.

## DISCUSSION

- The current study was unique in demonstrating a lack of social engagement in ASD at an early, pre-conscious level of physiological processing and supports the findings of a host of perceptual and behavioural studies.<sup>6,7</sup>
- Some degree of **intact processing** in ASD was observed in response to processing asynchronous information at the **physiological level** with ASD individuals showing similar patterns in pupillary response to changes in synchrony.
- The **Social Motivation Theory**<sup>8</sup> suggests that humans are biased to *orient* towards social stimuli, be *rewarded* by engagement in social interactions, and strive to *maintain* social bonds. A lack of engagement may result in decreased social skills and an increase in ASD symptoms. This hypothesis was supported by the negative associations between pupil size and ASD symptoms.
- Future research will determine whether pupillary responses can be used as a screening tool for diagnosis.
- Other clinical implications include using pupil responses as a pre/post intervention measurement, or as a possible biofeedback mechanism<sup>9,10</sup>.